Southern Squid Jig Fishery

Main features

**STATUS**
Uncertain in western Bass Strait; probably not overfished in other areas

**RELIABILITY OF THE ASSESSMENT**
No reliable assessment to date

**CURRENT CATCH**
2006: Jig fishery 619 t valued at approximately A$1.0 million; trawl byproduct 949 t

**LONG-TERM POTENTIAL YIELD**
Unknown

**MAIN MANAGEMENT OBJECTIVE**
Sustainable use and efficient exploitation of the squid resource

**MANAGEMENT METHODS**
Gear-based statutory fishing rights and annual determination of total allowable effort (TAE). Catch triggers are specified to signal the need for increased assessment and review of management arrangements
The management plan introduced in 2005 includes catch triggers for review of the fishery’s status and options for introducing total allowable catch (TAC) limits to the jig and trawl fisheries. The availability of arrow squid to jig fishers on the main fishing grounds in past years has been markedly variable: in 2002 for example, the jig catch (663 t) was less than half the 2001 catch of 1838 t. The 2003 to 2005 seasons have been more consistent, with annual catches in the range of 1239 t to 1668 t, but catch declined to 619 t in 2006.

**Highlights**

- The only squid species currently targeted in the Southern Squid Jig Fishery (SSJF) is the arrow squid (*Nototodarus gouldi*). In the SSJF they are caught only by squid-jigging operations; however, they are caught as a byproduct of other fishing, especially by trawling in the Southern and Eastern Scalefish and Shark Fishery (SESSF).
- Statutory fishing rights (SFRs) were granted to all SSJF permit holders in January 2006, and a TAE limit for 2006 was set at 800 standard jig machines.
- The management plan introduced in 2005 includes catch triggers for review of the fishery’s status and options for introducing total allowable catch (TAC) limits to the jig and trawl fisheries.
- The availability of arrow squid to jig fishers on the main fishing grounds in past years has been markedly variable: in 2002 for example, the jig catch (663 t) was less than half the 2001 catch of 1838 t. The 2003 to 2005 seasons have been more consistent, with annual catches in the range of 1239 t to 1668 t, but catch declined to 619 t in 2006.
Background

History of the fishery

Before 1972, the annual catch of arrow squid (*Nototodarus gouldi*) was less than 100 t, most of it byproduct of demersal trawling and Danish seining off south-eastern Australia. In December 1972, schools of arrow squid were located during squid-jigging trials in the Derwent Estuary near Hobart. In the next two months, up to 30 local vessels fished the schools with improvised jigging gear, taking a total of 154 t. Local interest in the potential of a squid jig fishery produced feasibility surveys of Tasmanian waters in 1972–73 and off Victoria in 1973–74, but did not result in the development of a jig fishery at that time.

Japanese commercial squid-jig vessels carried out feasibility fishing in southern waters during 1978–79 and 1979–80 under joint-venture partnerships with Australian companies. In the first year, 19 vessels caught 3387 t, and in the second, 64 vessels caught 7914 t, most of the catch being taken off South Australia, Victoria and Tasmania. Vessels from the Fishing Entity of Taiwan and South Korea subsequently fished in Bass Strait (and also off New Zealand) each season from 1983–84 to 1987–88, with annual catches ranging from 13 t to 2309 t. The most productive domestic waters fished were off northern Tasmania and in western Bass Strait. There has been no squid jigging by foreign vessels since 1988.

In 1987 there was only one local vessel actively fishing Bass Strait arrow squid using jig gear. Effort increased slowly up until 1995, the fleet size fluctuating between 7 and 17 vessels. Annual arrow squid catches in the SSJF did not exceed 400 t until the 1995 season, when 1260 t were landed. The success of the 1995 season generated increased interest from fishers holding jig endorsements and, as a result, about 40 vessels fished during 1996 and 1997. The 1997 arrow squid catch, about 2000 t, is the highest taken by domestic vessels. In the 10 years since 1997, there were seven seasons in which the total catch was well above 1000 t, and three years that yielded much less. The unpredictable nature of the jig fishery and low prices have caused a gradual reduction in the number of active vessels since 1997.

In most years, jig fishing has concentrated on known grounds in Bass Strait near Port Phillip Bay and in western Victoria south-east of Portland. However, in 1999 a large part of the catch was taken off eastern Victoria, and in 2000 most of the catch came from these same grounds. Waters outside Port Phillip Bay are usually fished in February and early March, and those in western Victoria from March to June. A very small proportion of fishing effort is directed outside the traditional fishing grounds.

The SSJF is almost exclusively a fishery for arrow squid. The fishery is managed by the Australian Government in waters beyond the coastal waters of New South Wales, Victoria, Tasmania, South Australia, and in a small area of oceanic water off southern Queensland. SSJF permit holders are restricted to the use of squid-jig gear, but may fish anywhere within the SSJF management area. Prior to 1999, there were restrictions on fishing area for many of the squid-jig permits. Within coastal waters (inside the 3 n.mile limit), squid jigging is managed by state governments.

Jig vessels operate at night using high-powered lamps to attract squid close to the boat, where they are caught on the jigs. Automatic jig machines take all of the catch. Fishing is carried out in continental-shelf waters, where depths range between 60 m and 120 m. The catch is chilled with flaked ice and landed the next morning for direct sale to processors. The success of squid jigging is greatly affected by the weather: heavy winds and swells in Bass Strait in winter effectively halt the jig fishery at that time. Moon phase also influences the catchability of arrow squid, with lower catch rates close to the full moon.

Species other than arrow squid form a very small bycatch of jigging. In the deeper shelf waters, Southern Ocean arrow squid (*Todarodes filippovae*) and red ocean squid
(Ommastrephes bartrami) constitute less than 1% of the catch. Occasionally, schools of pelagic sharks, especially blue shark (Prionace glauca), are attracted by the schooling squid, and barracouta (Thyrsites atun) frequently attack squid jigs and cause loss of jigs and lines. Operators generally move on to another area when this occurs. SSJF permits only allow the capture of squid, and operators must have appropriate line endorsements for targeting scalefish or shark species.

Arrow squid are also caught by trawl in the SSJF management area. They are a byproduct of demersal otter-trawling in the Commonwealth trawl sector of the SESSF (SESSF-CTS), but some fishers may target squid when markets are favourable. The annual catches ranged between 315 t and 884 t from 1986 to 2006. The main catches are taken on shelf grounds, particularly in depths of 100–200 m, most from heavily fished areas at these depths off New South Wales and the Victorian-South Australian border. Some squid are also taken in the Great Australian Bight trawl sector of the SESSF (SESSF-GABTS), which retained from 10 t to 262 t annually between 1986 and the 2006 peak landing. In northern New South Wales waters, squid are taken as a small component of byproduct in the Ocean Prawn Trawl Fishery. These squid are mainly Photololigo species, but some arrow squid are also caught.

Australia imports much more squid product than it produces domestically. Imports of squid were 11 300 t in 2004–05 and 12 500 t in 2005–06, most of it coming from China and New Zealand. However, sampling for the genetic study did not include specimens from Bass Strait, so further research would be required to confirm the genetic status of the commercially fished populations. The genetic relationship between New Zealand arrow squid and local populations is also unknown.

Initial research into the genetics of arrow squid supported existence of a single stock over most of its Australian distribution. The greatest genetic variation appeared in squid from northern NSW waters. However, sampling for the genetic study did not include specimens from Bass Strait, so further research would be required to confirm the genetic status of the commercially fished populations. The genetic relationship between New Zealand arrow squid and local populations is also unknown.

Arrow squid aggregate in large schools near the seabed during the day, and then disperse to some extent into the water column at night. Jig vessels are able to target aggregations for a few weeks or even months on the grounds off Portland. Arrow squid feed mainly at night, eating pelagic crustaceans, fish and squid, including smaller arrow squid.

**Biology**

Arrow squid inhabit southern Australian waters, including waters off Western Australia south of latitude 27°S and in the New Zealand Exclusive Economic Zone. They are typically caught on the continental shelf, but have been recorded over the continental slope to 500 m depth.

Arrow squid live for up to 1 year. The distribution of arrow squid larvae reveals that spawning occurs throughout the continental-shelf waters of southern Australia. They spawn throughout the year, but there may be peak periods of spawning activity. Recent research on arrow squid caught in the trawl fishery near Portland indicates the existence of up to four cohorts of squid each year. Short-lived squid species such as arrow squid typically produce a large number of eggs, but recruitment tends to be variable, probably regulated mainly by environmental factors. Reproductive studies suggest that arrow squid continue to grow during the spawning phase, and that females release a number of batches of fertilised eggs. Growth rates are extremely variable among years, seasons and locations. The age at maturity also varies according to season and location.

Initial research into the genetics of arrow squid supported existence of a single stock over most of its Australian distribution. The greatest genetic variation appeared in squid from northern NSW waters. However, sampling for the genetic study did not include specimens from Bass Strait, so further research would be required to confirm the genetic status of the commercially fished populations. The genetic relationship between New Zealand arrow squid and local populations is also unknown.

Arrow squid aggregate in large schools near the seabed during the day, and then disperse to some extent into the water column at night. Jig vessels are able to target aggregations for a few weeks or even months on the grounds off Portland. Arrow squid feed mainly at night, eating pelagic crustaceans, fish and squid, including smaller arrow squid.
The 2006 fishery

The 2006 jig fishery catch of 619 t was much less than catch from the previous two seasons. Fishing commenced outside Port Phillip Bay in January and continued into March. Over 500 t of arrow squid (or 85% of the 2006 catch) was taken from waters between Port Phillip Bay and Cape Otway. Fishing on the Portland ground was very limited in 2006 owing to poor catch rates—only 19% of the fishing effort was located on the Portland ground during a short season in March and April. A total of 4139 hours of jig fishing effort were used by 21 active jig vessels in 2006, less than half of the effort expended in 2005 when 20 vessels fished for 8836 hours. Prices paid for arrow squid ranged from A$1.80 to A$2.00 per kg, but operators experienced high fuel prices and poor catches.

The trawl catch of arrow squid was 949 t in 2006: 687 t from the SESSF-CTS, and 262 t from the SESSF-GABTS. The landings from the Great Australian Bight sector were the greatest recorded to date. The SESSF-CTS arrow squid landings and catch rates in 2006 were highest in January–May.

Current monitoring and research

Fishers have been required to complete daily catch and effort logbooks for the SSJF since 1996, the SESSF-CTS since 1986, and the SESSF-GABTS since 1987. Catch Disposal Record forms have been required from jig operators since January 2005, and trawl Catch Disposal Records have existed for squid since 2003. In 2005, there were 20 days of observer activity onboard SSJF vessels, but none in 2006 owing to low levels of fishing activity. The observers validate the quality of catch and bycatch reporting as well as collect sample data on arrow squid population parameters.

The University of Tasmania is undertaking research into the relationship between environmental factors (such as sea temperature and productivity) and the growth, reproduction and recruitment of arrow squid. The project is also comparing the biological composition of squid caught by jig with those caught by trawl, and assessing the feasibility of measuring juvenile squid abundance using light traps. This research follows a major study of arrow squid genetics, age, growth and maturation completed in 2004.

The Southern Squid Jig Fishery Resource Assessment Group (SquidRAG) advises the Southern Squid Jig Fishery Management Advisory Committee (SquidMAC) and the AFMA Research Committee on priorities for research into arrow squid stocks. The research priorities ranked highest in 2006 were stock assessment, life-history parameters, an understanding of the spatial and temporal distribution of squid populations, and collation of historical Australian squid data.
Status of stocks

Previous assessments
There are no formal stock assessments available for the arrow squid resource. Most of the information on the wider distribution and abundance of arrow squid has come from Japanese jig-fishing surveys conducted by the Japan Marine Fishery Resource Research Center between 1977 and 1981 and the foreign-licensed, joint-venture and feasibility fishing from 1978 to 1988. However, these data have not been used in any comprehensive assessment of the arrow squid resource.

2006 update
There was no stock assessment for the SSJF in 2006. Under the management plan there is a requirement for AFMA to determine reference points for squid, appropriate for maintaining ecologically viable stocks and an ecologically sustainable fishery. In the absence of scientific advice that fulfils this need, AFMA has set trigger catch limits of 4000 t for the SSJF (half the largest annual foreign jig catch in the AFZ) and 2000 t combined for the trawl fisheries. If the trigger is reached in any season, then AFMA will seek advice from the assessment group and relevant MACs on when to apply an overall squid TAC to the fisheries and what that amount should be.

In the absence of an agreed stock assessment, the fishery status of the SSJF can only be viewed as uncertain. However, the catch history of foreign jig vessels indicates that a jig fishery with fishing effort distributed more widely across the management area could safely harvest more than the current average annual landings.

Since 2003, there has been some shift from dependence on the Portland jig grounds to fishing in the area between Port Phillip Bay and Cape Otway. In the 2005 and 2006 seasons, the eastern jig catch rates were as good as or better than those from the Portland ground, which have been low compared with previous years. Since 2003 there has also been a noticeable decline in trawl catch rates of arrow squid off western Victoria. A careful examination of the catch-rate data is needed to identify possible causes for the decline. A possible cause is changes in fishing practices, including the depths fished.

Reference points
Current knowledge of the southern squid resource is insufficient to estimate biomass, and suitable proxies for reference points will also be difficult to determine. A precautionary approach has been taken by AFMA in setting trigger limits of 4000 t for the SSJF and 2000 t combined for the trawl fisheries. AFMA is currently reviewing the knowledge of the resource in consultation with the SquidMAC and SquidRAG, and considering how the requirements of the Draft Commonwealth Harvest Strategy Policy can best be addressed.
Future assessment needs

The SSJF Management Plan has a requirement for AFMA to determine reference points that are appropriate for maintaining ecologically viable squid stocks and an ecologically sustainable fishery, but to date this has not been possible. The Ministerial Direction to AFMA of December 2005 also requires the implementation of output controls in the form of individual transferable quotas (ITQs) in all fisheries by 2010, unless there are strong reasons why output controls should not be used. Although annual TACs and ITQs will be difficult to implement for the SSJF, there is likely to be a future need for estimation of multi-year TACs.

The outcomes of current research into environmental influences on recruitment and adult abundance will facilitate planning of future assessment directions. Options for use of trawl fishery logbook data and trawl survey data may provide benefits for assessments in the absence of other independent survey methods. Confirmation of population structure and patterns of squid movement within the fishery will also be necessary to determine whether stock assessment and management should be divided geographically.

Environmental issues

Only minimal environmental effects have been reported for the SSJF. The ecological risk assessment of the SSJF completed by CSIRO in 2005 did not identify any indicators of threat to the environment from jig fishing. The SSJF is one of the most benign fisheries assessed through this process. The assessment was supported by the then Department of the Environment and Heritage in its strategic assessment of the fishery under the Environment Protection and Biodiversity Conservation Act 1999.

The current bycatch action plan (BAP) for the SSJF was finalised in 2004 in conjunction with the strategic assessment process and the Ecological Risk Assessment project. Progress towards achieving the BAP’s objectives is being reported every six months by AFMA through its website, and the SSJF Management Plan requires review of the BAP every two years. There has been very little bycatch of fish species and no wildlife interactions reported to date. The occurrence of seals in the vicinity of jig vessels while fishing has been raised as a concern in the past. Research into this subject using onboard observers in 2002 showed no evidence of negative effects on seals from jig fishing.

Further reading


Management performance

Since determination of the Southern Squid Jig Fishery Management Plan 2005, management of the SSJF has focussed on the introduction of SFRs and other administrative aspects of the management plan such as the setting and allocation of the TAE for 2006 and 2007. The SquidMAC and SquidRAG met twice at joint meetings in 2006. Matters dealt with by these meetings included the setting of the TAE, the BAP review, and initial discussion of how the Draft Commonwealth Harvest Strategy Policy should be addressed. Implementation of the Policy is one of the main requirements of the Ministerial Direction to AFMA. The Policy will present a challenge for AFMA in 2007 in terms of agreement on suitable fishery reference points or trigger limits and planning for appropriate data collection and fishery assessment across the jig and trawl fisheries. The introduction of vessel-monitoring systems (VMS) for all vessels and ongoing observer coverage are additional costs for AFMA and industry, but also provide an opportunity to provide a better-integrated fishery monitoring system.

AFMA has set the TAE for 2007 at the same level as in 2006, i.e. 800 standard jig machines. It is unlikely that TAE will be limiting on jig fishers for the next few years. However, if the jig trigger limit of 4000 t is reached in one season, then the management arrangements will be reviewed and more constrained limits may be required. This would also require decisions on apportionment of a squid TAC. The AFMA Board Policy on apportionment of a squid TAC for the SSJF is likely to be reviewed in conjunction with the instigation of a harvest strategy. The TAE is based on the average catch per jig machine from the Japanese joint-venture fleet in the late 1970s and the calculated number of jig machines required to take 4000 t of squid. Given the catch rates achieved by SSJF boats in some years, a catch far greater than the 4000 t trigger is possible if all SFRs are allocated to boats. If there is a significant increase in the number of vessels actively fishing the jig grounds, then the focus may shift to determining a suitable TAC and the practical application of such a limit in terms of a TAE.

The equivalent of 16 concessions were removed from the SSJF under the voluntary fishing concession buy-back programme Securing Our Fishing Future funded by the Australian Government in 2006. Removal of the associated SFRs will have minimal impact on the jig fishery in 2007, and its effect on future fishing capacity will depend on the implementation process for the annual allocating of jig machine numbers to SFR holders.

There is continuing interest from trawl fishers in arrow squid as an alternative target species. AFMA has provision for issuing of scientific permits to target arrow squid in the SESSF-GABTS using mid-water trawl gear. No applications have been submitted, but such projects would require additional support in terms of observer coverage and analysis of catch-and-effort data.